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Environmental Data Collection Using Autonomous Wave Gliders

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Overview

- Wave Glider (SHARC)
- What – CRUSER Funded Research Goals
- Why – Naval Applications
- How – Sensor Integration and Field Tests
- Results
- Future Work

SHARC

- Created by LRI in 2007
- Wave-powered
  - 1.5 kts average
  - 1 year endurance!
- Two empty payload bays
- Nav/Comms
  - Iridium
- Uses
- NPS has two SHARCs!

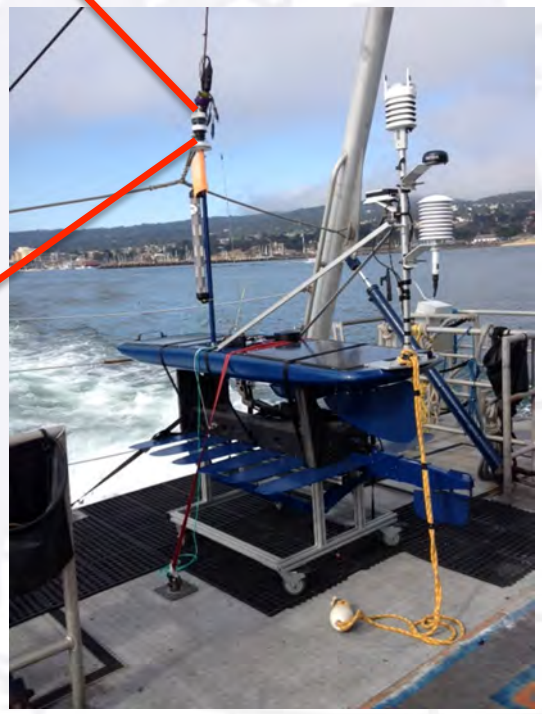
Original SHARC Sensor

- Mako
- LRI Basic METOC model
  - –AIRMAR PB200 weather station

  Pressure, Temperature,

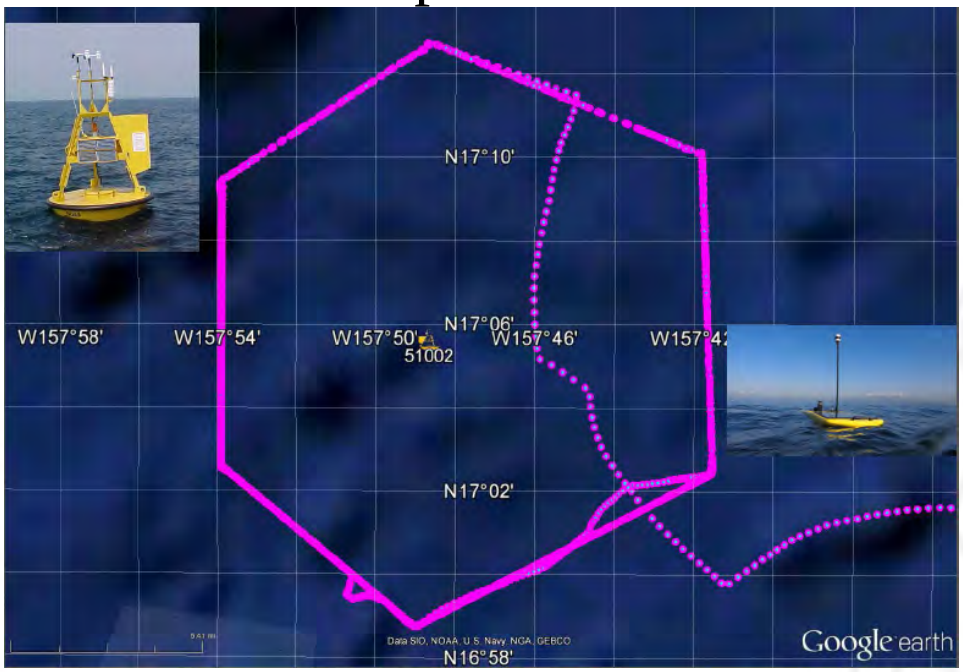
  Wind Speed and Direction

  10 min averaged data

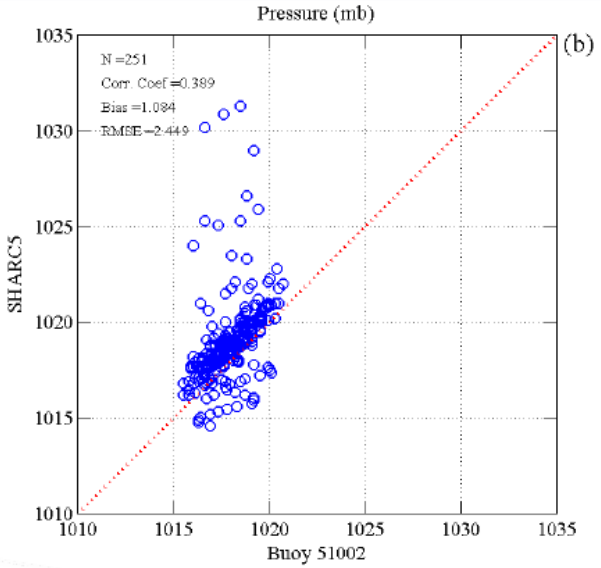


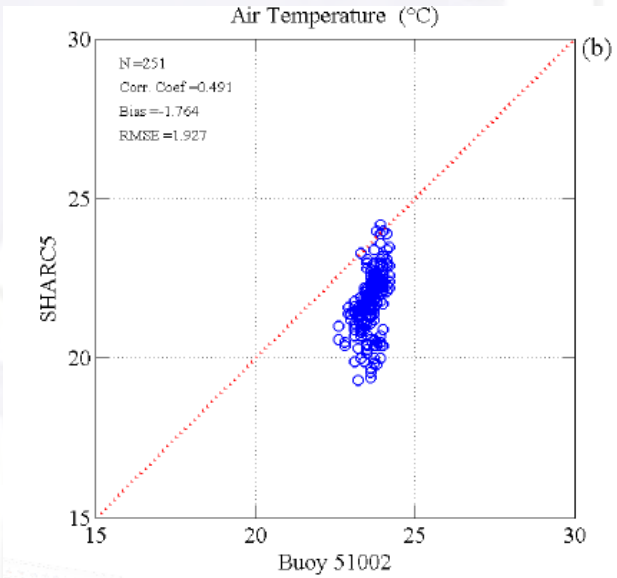
Previous Evaluation Efforts

- Existing measurements
  - –NAVO comparisons



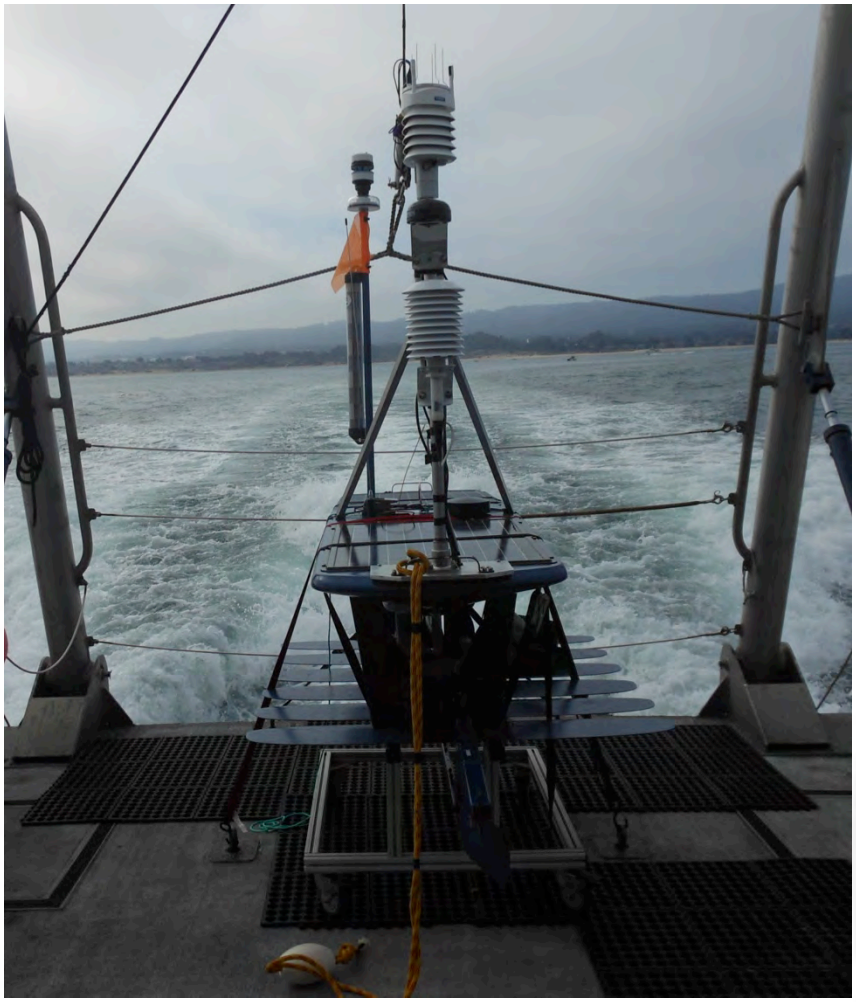
(David Wang, NRL, 2012)





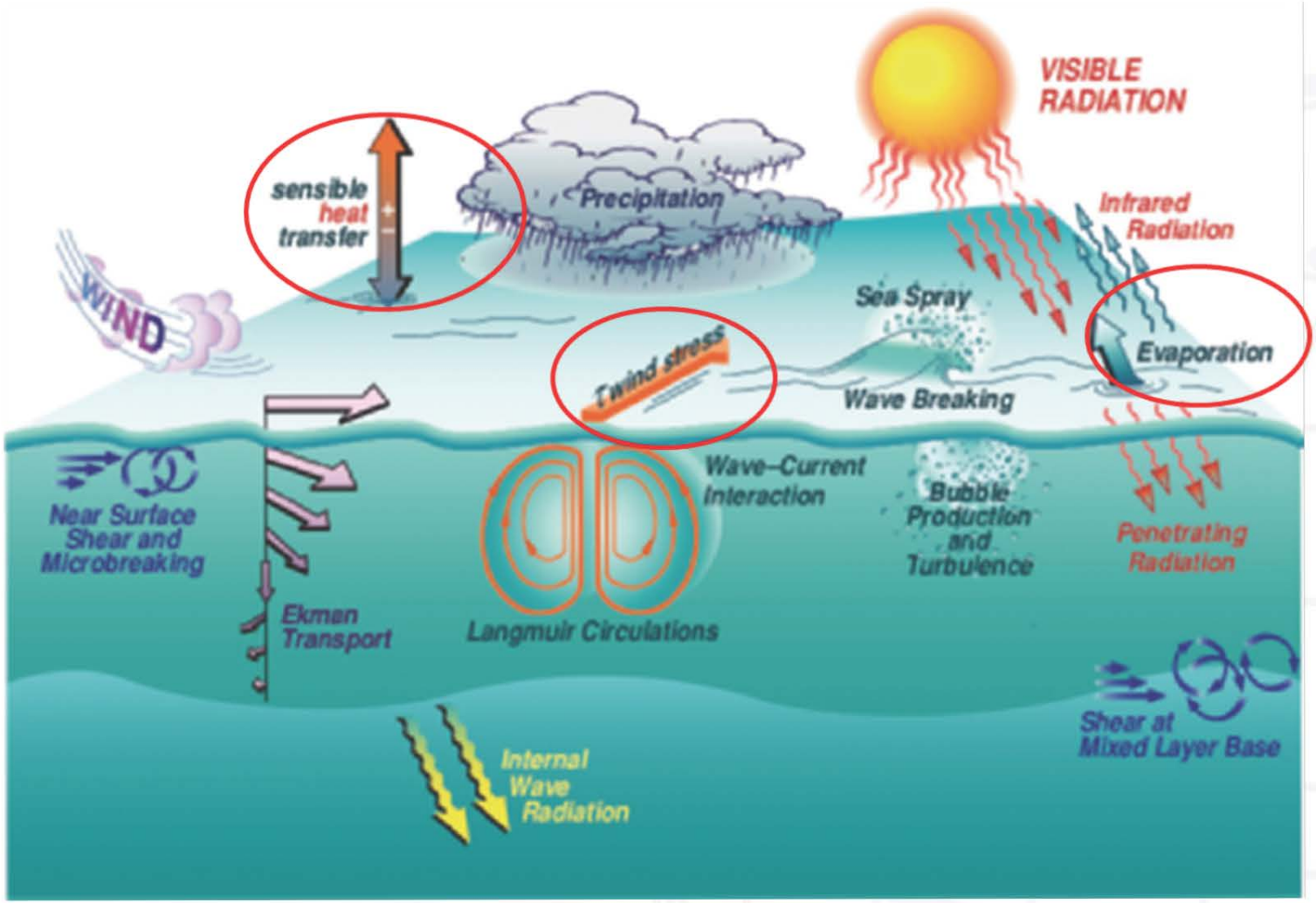
- –PacX Data

Project Objectives



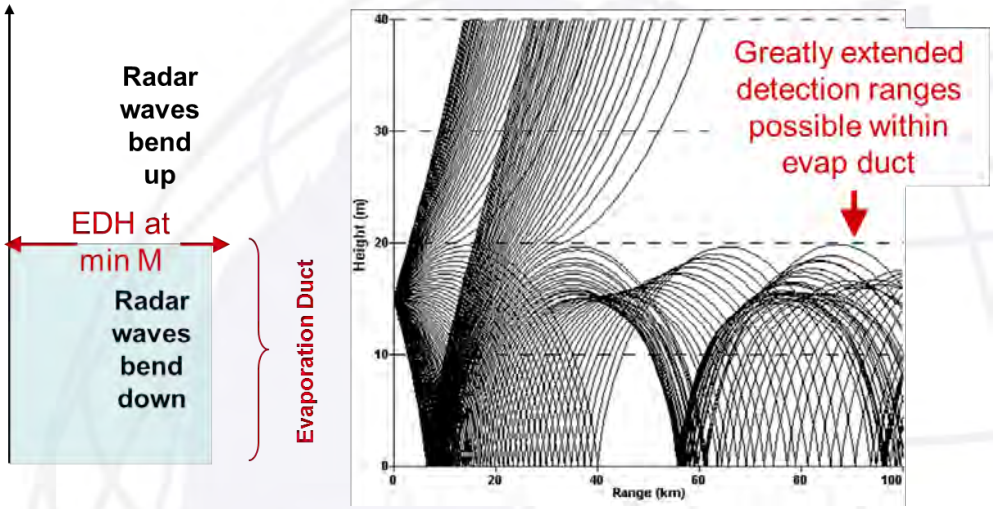
- Evaluate default SHARC METOC sensor
- Develop and integrate new METOC payload using sensors with known measurement quality
- Field experiment for Airmar and new METOC payload evaluation
  - –Co-deploy SHARC with NPS MASFlux Buoy
- Evaluate SHARC as a platform for near-surface data collection for various Naval applications
  - –Electromagnetic (EM) wave propagation
  - –Forecast model evaluation

Near-Surface Physical Processes



Naval Applications

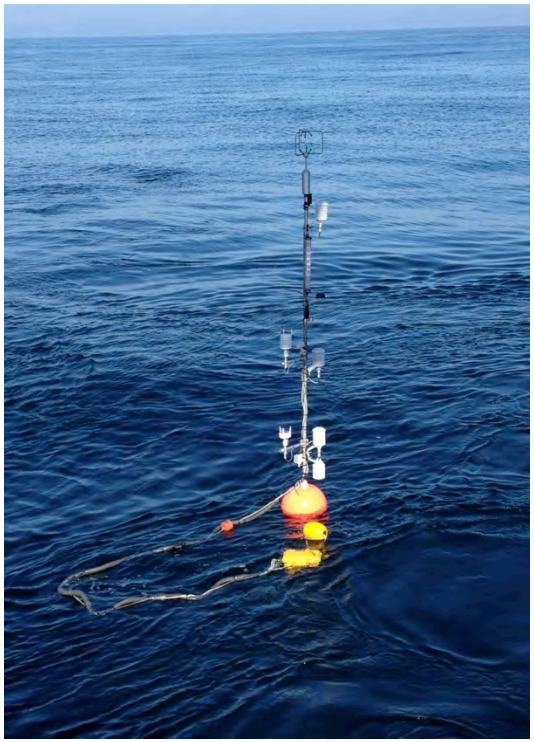
- Forecast Evaluation and Improvement
  - –Near-surface observations
  - –Coupled model
  - –Surface flux parameterization
- EM Propagation
  - –Evaporative duct study
  - –Observations for input into operational propagation models as tactical decision aids



(Frederickson et al, 2000)

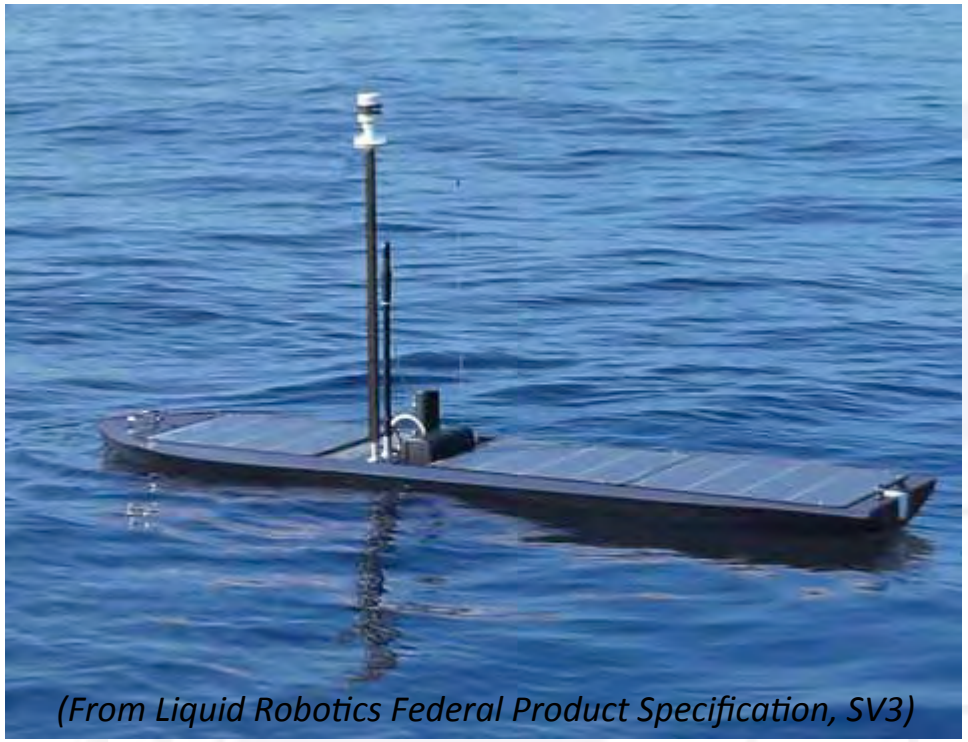
SHARC as a METOC Platform

Marine Air-Sea Flux (MASFlux) Buoy



Direct flux measurements
Bulk flux estimates
2-D wave spectra
Top water layer temperature

Fixed location/drifting
Limited sea conditions



(From Liquid Robotics Federal Product Specification, SV3)

Bulk flux estimates
2-D wave spectra
Water temperature profile

Autonomous
Broad sea conditions

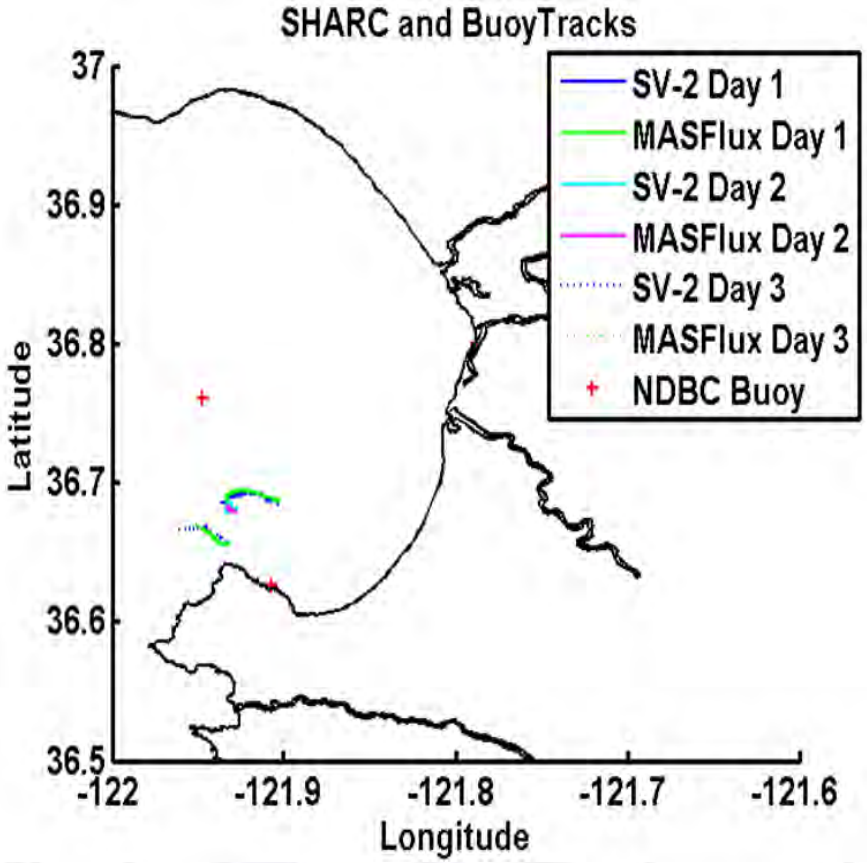
Instrument Development

New METOC Mast for SHARC

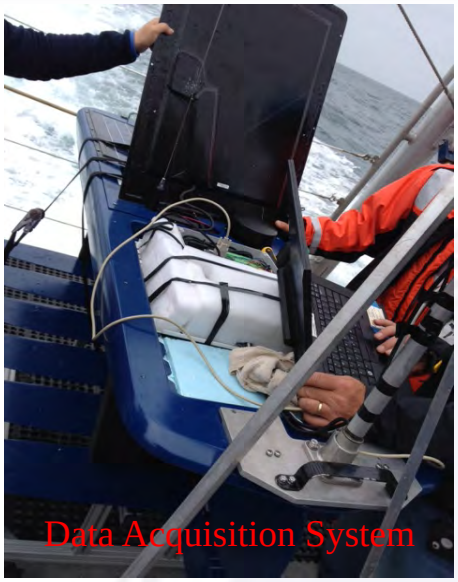
Sensor	Measured variables
Rotronic Model MP100H	Temperature Relative humidity
Vaisala Weather Transmitter WTX520	Wind speed and direction Barometric pressure Temperature Relative Humidity
Campbell Scientific Temperature Probe Model 109SS	Sea water temperature
Garmin GPS16-HVS	Position Velocity Magnetic declination
True North Revolution Technologies GS Gyro Stabilized Electronic Compass	Heading Pitch Roll
VectorNav VN-100 Rugged Accelerometer	Angular rates, linear accelerations Magnetic field components

METOC Payload At Sea Testing

- Three deployments
  - –Monterey Bay
  - –Day 3: 1.5 m swells!
- Five hours of data collected each underway
- Deployment / Recovery
  - –Non-trivial!



The Fun Stuff!



Deployment / Recovery

- Challenging!
  - Ensure safety and security of sensors and SHARC
- Used Fulmar A-Frame
- Progressively added taglines
  - Increased stability
  - Decreased risk of collision between SHARC and R/V

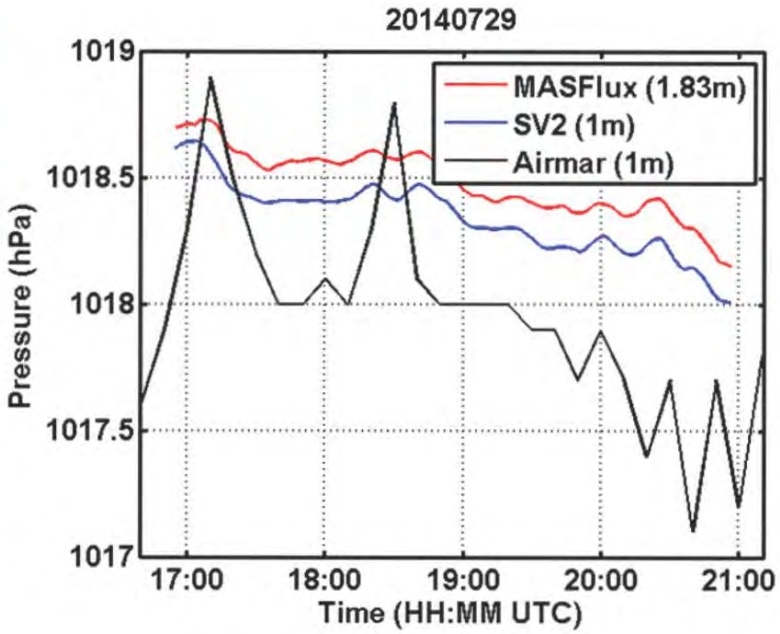
- Training:

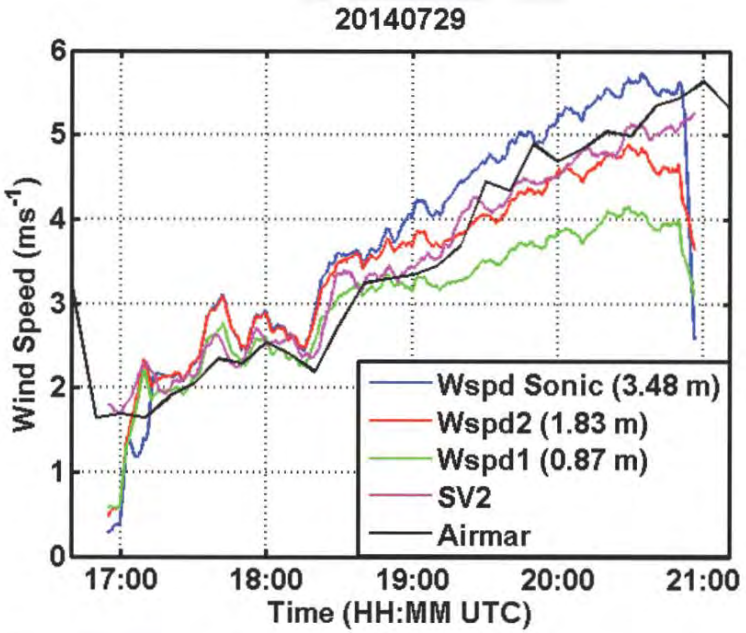
Training Recovery.MOV

- Final Day of Field Work:

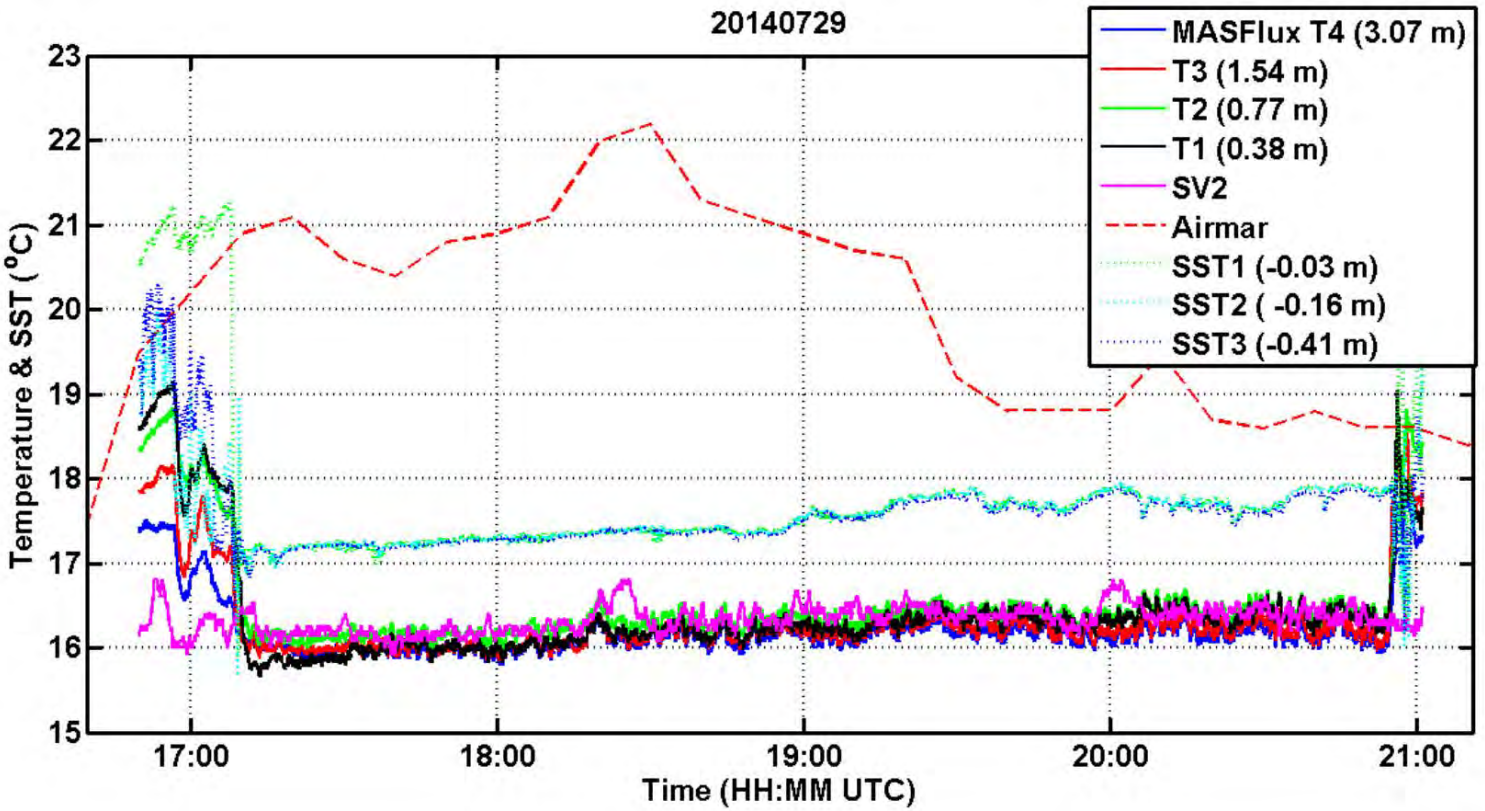
Recovery-Day3-cut.mp4

Initial Results





Initial Results (cont)



Ongoing Evaluation

- Static Comparison
- Controlled Environment
  - Eliminate SHARC movement
  - Eliminate Airmar algorithm
    - Sampled at same rate (1 Hz)
    - Compare raw data

Future Work

- Further data analysis
- Paves the way…
- CASPER (presentation by Qing Wang Nov 03 CRUSER Monthly meeting)
  - Duck, NC
  - Southern CA
- EM Propagation
- Direct Flux Sensing payload
  - Including water vapor flux!
    - Not currently available at near-surface level

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Questions/Comments